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PRELIMINARY TESTS OF SYNTHETIC ORGANIC COMPOUNDS
AS INSECTICIDES. PART VI

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This is the sixth of a series of papers reporting preliminary tests with miscellaneous synthetic organic compounds, which were started at the insecticide-testing laboratory of this Bureau at Sanford, Fla., and continued at Anaheim, Calif. In the previous papers (E-621, E-634, E-729, E-738, and E-744) tests with approximately 1,200 compounds are reported. In this paper are given the results obtained from 89 compounds not previously reported and which were tested from January 1946 to March 1949. The Division of Insecticide Investigations supplied all samples.

All compounds were tested as dusts against at least three species of insects; many of the more toxic materials were tested against six or seven species. The following species were used:

Alder flea beetle (Altica ambiens (Lec.))
Armyworm (Cirphis unipuncta (Haw.))
Cabbage aphid (Brevicoryne brassicae (L.))
California oakworm (Phryganidia californica Pack.)
Celery leaf tier (Phlyctaenia rubigalis (Guen.))
Citrus red mite (Paratetranychus citri (McG.))
Green dock beetle (Gastrophysa cyanea Melsh.)
Large milkweed bug (Oncopeltus fasciatus (Dall.))
Pea aphid (Macrosiphum pisi (Kltb.))
Two-spotted spider mite (Tetranychus bimaculatus Harvey)
Variegated cutworm (Peridroma margaritosa (Haw.))

The armyworm, the celery leaf tier, the large milkweed bug, the pea aphid, and the variegated cutworm were reared in the laboratory; all others were collected in the field. In general the equipment and methods employed remain essentially the same as those described by Swingle, Phillips, and Gahan (1).

In most of the tests with coleopterous or lepidopterous larvae 24 insects were used per test; a minimum of 20 milkweed bugs were used, and the number of aphids and mites ranged from around this minimum to several times this number. The test period was usually 2 days.

When received for testing, the samples had been diluted to 25, 10, or 5 percent in pyrophyllite, and generally were in good physical condition for dusting.

Materials causing mortalities of 75 percent or higher as dusts were applied as sprays to leaves of five or more kinds of plants to determine their toxicity to green foliage.

For comparative purposes tests were made with ~~gamma~~ benzene hexachloride (lindane), 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane (DDT), bis(p-chlorophenoxy)methane, and O,O-diethyl O-p-nitrophenyl thiophosphate (parathion). The results of these tests are shown in table 1.

Data on 11 organic compounds that caused greater than 74 percent mortality to one or more species of insects in dust tests are shown in table 2.

Two samples of 1,1,1-trichloro-2,2-bis(p-fluorophenyl)ethane, pure and technical grades, were each effective against six of the seven insects against which they were tested. Neither sample was effective against the citrus red mite, but both were effective against the egg and the active stages of the two-spotted spider mite.

Meso-alpha, alpha, 4,4'-tetrachlorobibenzyl was effective against two species of lepidopterous larvae and the pea aphid, but not against nymphs of the large milkweed bug or active stages of the two-spotted spider mite. These materials were effective as both stomach poisons and contact insecticides. Cis-alpha, 4,4'-trichlorostilbene was effective against the egg and the active stages of the two-spotted spider mite and nymphs of the pea aphid, an indication of considerable toxic action as a contact poison. Absence of mortality among larvae of the armyworm and the celery leaf tier fed foliage treated with this compound is evidence that it does not act as a stomach poison.

Of the most toxic materials, only cis-alpha, 4,4'-trichlorostilbene caused noticeable injury to green foliage, and this was only very slight to bean and pumpkin plants, which soon recovered.

Table 3 gives the results of tests against various insects with 29 compounds that killed between 25 and 74 percent of a species. However, only five of the compounds caused mortalities of 60 percent or higher. The compounds and insects against which they were effective are isopropyl ester of 3,4-dichlorobenzoic acid (celery leaf tier); p-chlorohippuric acid (pea aphid); 4-benzylidene-3-methyl-5(4)-isoxazalone (armyworm and celery leaf tier); p-~~tort~~-butylphenyl ester of p-nitrobenzoic acid (armyworm); 2,3,6,7-tetrachloro-5,6,7,8-tetrahydro-1,4-naphthaquinone (pea aphid).

The compounds that caused less than 25 percent mortality of the species tested are listed in table 4.

Literature Cited

- (1) Swingle, M.C., Phillips, A.M., and Gahan, J.B.
1941. Laboratory testing of natural and synthetic organic
substances as insecticides. Jour. Econ. Ent. 34:95-99.

Table 1. - Effectiveness of four insecticides tested against various species of insects fed dusted foliage, to be used as standards for comparing results obtained with new compounds as insecticides

Compound	Percent	Insect	Stage	Foliage	Feeding	Average deposit per square centimeter	Percent	Average kill after 2 days	5 days
Pea aphid	5	Pea aphid	2-day-old nymphs	Windsor bean	-	215	86	-	
Cabbage aphid	2	Cabbage aphid	Nymphs and adults	Orange leaf	-	95	100	-	
Large milkweed bug	.5	Large milkweed bug	Second-instar nymphs	Milkweed seed	-	125	100	-	
Pea aphid		Pea aphid	2-day-old nymphs	Windsor bean	-	110	100	-	
Large milkweed bug	.25	Large milkweed bug	Third-instar nymphs	Milkweed seed	-	140	70	-	
Pea aphid		Pea aphid	2-day-old nymphs	Windsor bean	-	75	92	-	
Large milkweed bug	.2	Large milkweed bug	Third-instar nymphs	Milkweed seed	-	200	100	-	
Armyworm	.125	Armyworm	Fourth instar	Barley	Moderate	265	75	-	
Two-spotted spider mite	2	Two-spotted spider mite	Nymphs and adults	Lima bean	-	185	-	75	
Citrus mite	1	Citrus mite	Eggs	Orange fruit	-	250	10 in 7 days	-	
Two-spotted spider mite		Two-spotted spider mite	Nymphs and adults	Castor bean	-	220	-	78	
Citrus mite	.5	Citrus mite	do.	Orange fruit	-	295	100	-	
do.	.5	do.	do.	do.	-	170	-	100	
Two-spotted spider mite	.1	Two-spotted spider mite	do.	Castor bean	-	110	-	95	
do.	.025	do.	do.	do.	-	170	-	78	
do.	.0125	do.	do.	do.	-	185	-	87	

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Table 1. - - (Continued)

Compound	Insect	Stage	Foliage	Feeding	Average deposit per square centimeter	Average kill after	
						2 days	3 days
Percent	Micrograms					Percent	Percent
1,1,1-Trichloro- 2,2-bis(p- chlorophenyl)- ethane (DDT)	Armyworm	2.5	Third-instar nymphs	Barley	None	235	- 96
			Fourth instar	Swiss chard	Slight	155	- 100
			do.	Dock	Much	150	- 29
2	Large milkweed bug	Nymphs	Milkweed seed	-	200	- 97	
		Fourth instar	Corn leaves	Moderate	170	- 63	
		Nymphs	Milkweed seed	-	265	86 -	
1	Large milkweed bug	Third instar	Alder	Slight	355	- 100	
		do.	Swiss chard	do.	200	- 58	
		do.	Alder	do.	230	- 100	
.5	Armyworm	Fourth instar	Barley	Moderate	149	- 79	
		do.	Oak leaves	Slight	110	- 100	
		do.	Swiss chard	do.	230	- 96	
	Green dock beetle	do.	Dock	do.	150	- 100	
		2-day-old nymphs	Windsor bean	-	200	92 -	
		Fourth instar	Malva	Slight	155	- 100	
.2	Variegated cutworm	Third instar	Swiss chard	do.	155	- 92	

Table 2. - - Compounds causing greater than 74 percent mortality of one or more species of insects fed dusted foliage

Compound	Insect	Stage	Feeding	Average deposit		Average Kill	
				per square centimeter		after 2 days	after 3 days
Percent							
				Micrograms	Percent	Percent	
Benzoic acid, 2,4-dichloro-, 2-methyl-2-nitropropyl ester	5 Armyworm	Third instar	Moderate	280	-	0	
	Green dock beetle	Fourth instar	Much	205	-	100	
	Large milkweed bug	Third-instar nymphs	-	250	10	-	
	Poa aphid	2-day-old nymphs	-	215	0	-	
	Two-spotted spider mite	Nymphs and adults	-	250	-	35	
Ribenzyl, meso-alpha, alpha', 4,4'-tetrachloro-	25 California oakworm	Fourth instar	Moderate	270	-	63	
	Celery leaf tier	do.	Slight	300	-	95	
	Large milkweed bug	Nymphs	-	340	5	-	
	Poa aphid	2-day-old nymphs	-	200	100	-	
	Two-spotted spider mite	Nymphs and adults	-	235	-	22	
Bicyclo[2.2.1]-5-heptene-2,3-dicarboximide, N-(2-ethylhexyl)-	5 Alder flea beetle	Third instar	Moderate	325	-	25	
	Celery leaf tier	Fourth instar	Much	370	-	4	
	do.	do.	do.	265	-	50	
	do.	Third instar	Moderate	215	-	0	
	Large milkweed bug	Second-instar nymphs	-	200	15	-	
0,0-Diethyl O-2-nitrophenyl phosphate	Poa aphid	2-day-old nymphs	-	400	32	-	
	Green dock beetle	Fourth instar	Much	310	4	-	
	Two-spotted spider mite	Nymphs and adults	-	220	-	91	
	10 Citrus mite	Eggs	-	200	17 in 7 days	-	
	Large milkweed bug	Third-instar nymphs	-	230	30	-	
do.	do.	do.	-	250	65	-	
	Poa aphid	2-day-old nymphs	-	215	83 in 1 day	-	
	Two-spotted spider mite	Eggs	-	155	39 in 4 days	-	

Table 2. -- (Continued)

Compound	Insect	Stage	Feeding	Average deposit per square centimeter	Percent	
					Micrograms	Percent
Ethane, 1,1,1-trichloro-2,2-bis(p-fluorophenyl)- (pure)	25 Cabbage aphid	Nymphs and adults	-	200	85	-
	California oakworm	Fourth instar	Slight	200	-	100
	Celery leaf tier	do.	do.	270	-	100
	Citrus mite	Nymphs and adults	-	280	-	0
	Large milkweed bug	Nymphs	-	265	100	-
	Two-spotted spider mite	Eggs	-	230	-	96
Ethane, 1,1,1-trichloro-2,2-bis(p-fluorophenyl)- (technical)	do.	Nymphs and adults	-	200	-	100
	25 Cabbage aphid	do.	-	200	88	-
	California oakworm	Fourth instar	Slight	150	-	96
	Celery leaf tier	do.	do.	250	-	100
	Citrus mite	Nymphs and adults	-	240	-	0
	Large milkweed bug	Nymphs	-	200	86	-
Ethylenediamine, bis(disalicylal)-, nickel derivative,	Two-spotted spider mite	Nymphs and adults	-	215	-	100
	do.	Eggs	-	230	-	100
	25 Celery leaf tier	Fourth instar	Moderate	225	-	35
	Pea aphid	2-day-old nymphs	-	215	85	-
	Two-spotted spider mite	Nymphs and adults	-	265	0	-
	Variiegated cutworm	Third instar	Moderate	200	-	13
p-Nitrobenzoic acid, 2,4,6-trichloro-phenyl ester	25 Alder flea beetle	do.	do.	310	-	0
	Armyworm	Fourth instar	do.	230	-	0
	Celery leaf tier	do.	do.	250	-	92
	Two-spotted spider mite	Nymphs and adults	-	200	-	13
	Variiegated cutworm	Fourth instar	Much	230	-	0
	10 Armyworm	Third instar	Moderate	200	-	0
Rhodanine, 5-ethylidene-	Celery leaf tier	do.	do.	200	-	8
	Citrus mite	Nymphs and adults	-	230	-	54
	Green dock beetle	Fourth instar	Moderate	200	-	54
	Pea aphid	2-day-old nymphs	-	250	22 in 1 day	-
	Two-spotted spider mite	Nymphs and adults	-	215	89	-

Table 2. - - (Continued)

Compound	Insect	Stage	Feeding	Average deposit		Average Kill
				per square centimeter	after 2 days 3 days	
Percent						
Stilbene, <i>cis</i> -alpha, 4,4'-trichloro-	25 Celery leaf tier	Fourth instar	Moderate	320	-	0
	Pea aphid	2-day-old nymphs	-	250	63	-
	Two-spotted spider mite	Eggs	-	310	-	100
	do.	Nymphs and adults	-	320	-	90
Sulfone, p-chloro-benzyl p'-chloro-phenyl	25 Armyworm	Third instar	Moderate	250	0	-
	Cabbage aphid	Nymphs and adults	-	250	17	-
	Celery leaf tier	Third instar	Moderate	250	29	-
	Pea aphid	2-day-old nymphs	-	370	100	-
	Two-spotted spider mite	Nymphs and adults	-	250	-	0
	do.	do.	-	200	15	-

Table 3. - - Compounds causing from 25 to 74 percent mortality of one or more species of insects fed dusted foliage

Compound	Percent	Insect	Stage	Feeding	Average deposit per square centimeter	Average kill		
						2 days	3 days	after
Percent								
Micrograms								
Acetoacetic acid, <u>alpha</u> , 10 <u>alpha</u> -bis(2-cyanoethyl)-, <u>ethyl</u> ester,		Armyworm	Fourth instar	Much	230	-	-	29
		Celery leaf tier	Third instar	Moderate	215	-	-	13
		Green dock beetle	Fourth instar	Much	230	8	-	-
		Pea aphid	2-day-old nymphs	-	200	0 in 1 day	-	0
		Two-spotted spider mite	Nymphs and adults	-	250	-	-	-
Acetoacetic acid, <u>alpha</u> , 10 <u>alpha</u> -bis(2-cyanoethyl)-, <u>methyl</u> ester,		Armyworm	Fourth instar	Much	200	-	-	33
		Celery leaf tier	Third instar	do.	200	-	-	8
		Green dock beetle	Fourth instar	do.	280	21	-	-
		Pea aphid	2-day-old nymphs	-	250	0 in 1 day	-	0
		Two-spotted spider mite	Nymphs and adults	-	265	-	-	-
Benzoic anhydride, <u>p</u> -chloro-	25	Celery leaf tier	Fourth instar	Moderate	250	-	-	8
		Pea aphid	2-day-old nymphs	-	240	58	-	-
		Variegated cutworm	Third instar	Much	265	-	-	8
Benzoic acid, <u>o</u> -benzamidophenyl ester,	25	Celery leaf tier	Fourth instar	do.	250	-	-	0
		Pea aphid	2-day-old nymphs	-	280	10	-	-
		Two-spotted spider mite	Nymphs and adults	-	235	-	-	37
Benzoic acid, 2,4- dichloro-, <u>o</u> -chloro- phenyl ester,	5	Celery leaf tier	Third instar	Much	215	-	-	21
		Pea aphid	Adults	-	215	0	-	-
		Two-spotted spider mite	Nymphs and adults	-	265	26	-	-
Benzoic acid, 3,4- dichloro-, <u>o</u> -chloro- phenyl ester,	5	Celery leaf tier	Fourth instar	Much	265	-	-	38
		Pea aphid	2-day-old nymphs	-	220	0	-	-
		Two-spotted spider mite	Nymphs and adults	-	310	14	-	-

Table 3. - - (Continued)

Compound	Insect	Stage	Feeding	Average deposit per square centimeter	Average kill after	
					2 days	3 days
Percent						
				Micrograms	Percent	Percent
Benzoic acid, 3,4-dichloro-, isopropyl ester	5 Armyworm	Third instar	Moderate	280	-	25
	Celery leaf tier	Fourth instar	do.	350	-	67
	Green dock beetle	do.	Much	280	-	0
	Pea aphid	2-day-old nymphs	-	200	9	-
	Two-spotted spider mite	Nymphs and adults	-	280	-	0
Benzoic acid, p-nitro-, 2,4-dichlorophenyl ester	25 Armyworm	Fourth instar	Much	200	-	0
	Celery leaf tier	do.	do.	280	-	46
	Variegated cutworm	do.	do.	200	-	0
Benzoic acid, p-nitro-, p-nitrophenyl ester	25 Armyworm	do.	do.	280	-	41
	Celery leaf tier	do.	do.	310	0	-
	Variegated cutworm	do.	do.	280	-	0
Benzoic acid, p-nitro-, p-tert-butylphenyl ester	25 Armyworm	do.	Moderate	350	-	63
	Celery leaf tier	do.	Much	310	-	42
	Variegated cutworm	do.	do.	350	-	0
Benzoic acid, p-nitro-, o-tolyl ester	25 Armyworm	do.	do.	300	-	44
	Celery leaf tier	do.	do.	310	-	40
	Variegated cutworm	do.	do.	300	-	4
Benzoic acid, p-nitro-, p-tolyl ester	25 Armyworm	do.	do.	260	-	0
	Celery leaf tier	do.	do.	280	-	42
	Variegated cutworm	do.	do.	260	-	12
Benzoin, 4,4'-dichloro-	25 Celery leaf tier	do.	Moderate	340	-	4
	Pea aphid	2-day-old nymphs	-	310	27	-
	Two-spotted spider mite	Nymphs and adults	-	250	-	42

Table 3. - - (Continued)

Compound	Insect	Stage	Feeding	Average deposit		Average kill	
				per square centimeter	after	2 days	3 days
<u>Percent</u>							
Bibenzyl, <u>alpha, alpha'-dibromo-alpha, 4,4'-trichloro-</u>	10	Armyworm	Fourth instar	Moderate	200	-	46
		Celery leaf tier	Third instar	Much	200	-	12
		Pea aphid	2-day-old nymphs	-	215	0 in 1 day	-
		Two-spotted spider mite	Nymphs and adults	-	250	-	0
Bibenzyl, <u>dl-alpha, alpha', alpha'-4,4'-pentachloro-</u>	5	Celery leaf tier	Third instar	Much	280	-	0
		Pea aphid	Adults	-	250	0	-
		Two-spotted spider mite	Nymphs and adults	-	250	32	-
Bibenzyl, <u>dl-4,4'-tetrachloro-</u>	25	Celery leaf tier	Fourth instar	Moderate	250	-	13
		do.	do.	do.	265	-	26
		Pea aphid	2-day-old nymphs	-	200	14	-
		Two-spotted spider mite	Nymphs and adults	-	280	-	53
Ethane, hexachloro-, <u>beta-pinene, addition product (5% Cl)-</u>	5	Celery leaf tier	Third instar	Much	280	-	8
		Pea aphid	Adults	-	250	9	-
		Two-spotted spider mite	Nymphs and adults	-	230	40	-
Ethylenediamine, bis (disalicyl)-, copper derivative	25	Celery leaf tier	Fourth instar	Much	310	-	0
		Pea aphid	2-day-old nymphs	-	265	46	-
		Two-spotted spider mite	Nymphs and adults	-	215	0	-
Hippuric acid, <u>p-chloro-</u>	25	Celery leaf tier	Fourth instar	Much	232	-	4
		Pea aphid	2-day-old nymphs	-	210	65	-
		Two-spotted spider mite	All stages	-	280	0	-
5(4)-Isoxazolone, 4-benzylidene-3-methyl-	10	Armyworm	Fourth instar	Moderate	215	-	71
		Celery leaf tier	Third instar	Slight	215	-	63
		Green dock beetle	Fourth instar	do.	255	58	-
		Pea aphid	2-day-old nymphs	-	215	0 in 1 day	-
		Two-spotted spider mite	Nymphs and adults	-	230	-	0

Table 3. - - (Continued)

Compound	Percent	Insect	Stage	Feeding	Average deposit per square centimeter	Average kill after		
						2 days	3 days	Percent
Micrograms								
Methanetripropionitrile, <u>p</u> -bromobenzoyl-	10	Armyworm	Fourth instar	Much	230	-	-	17
		Celery leaf tier	Third instar	Moderate	310	-	-	33
		Pea aphid	2-day-old nymphs	-	250	0 in 1 day	-	0
		Two-spotted spider mite	Nymphs and adults	-	230	-	-	0
Methanetripropionitrile, 3,4-dichlorobenzoyl	10	Armyworm	Third instar	Much	230	13	-	-
		Celery leaf tier	do.	do.	200	8	-	-
		Pea aphid	2-day-old nymphs	-	250	0 in 1 day	-	54
		Two-spotted spider mite	Nymphs and adults	-	250	-	-	54
3-Naphthoic acid, 1,1-methylenebis[2-hydroxy-	25	Celery leaf tier	Fourth instar	Moderate	220	-	-	33
		Pea aphid	2-day-old nymphs	-	290	0	-	-
		Two-spotted spider mite	Nymphs and adults	-	220	19	-	-
1,4-Naphthaquinone, 2,3,6,7-tetrachloro-5,6,7,8-tetrahydro-	25	Celery leaf tier	Fourth instar	Moderate	210	-	-	13
		Pea aphid	2-day-old nymphs	-	220	70	-	-
		Two-spotted spider mite	All stages	-	220	0	-	-
Stilbene, trans-alpha, 4,4'-trichloro-	25	Celery leaf tier	Fourth instar	Moderate	250	-	-	13
		Pea aphid	2-day-old nymphs	-	200	24	-	-
		Two-spotted spider mite	Nymphs and adults	-	295	-	-	31
Stilbene, dl-dichloro-	10	Armyworm	Fourth instar	Moderate	200	-	-	41
		Celery leaf tier	Third instar	Much	200	-	-	0
		Green dock beetle	Fourth instar	do.	200	-	-	0
		Pea aphid	3-day-old nymphs	-	200	0 in 1 day	-	-
		Two-spotted spider mite	Nymphs and adults	-	230	0	-	-
Sulfone, <u>p</u> -anisyl chloromethyl-	25	Celery leaf tier	Fourth instar	Much	295	-	-	29
		Pea aphid	Nymphs	-	340	-	-	49
		Two-spotted spider mite	Nymphs and adults	-	370	0	-	-

Table 3. - - (Continued)

Compound	Insect	Stage	Feeding	Average deposit		Average kill	
				per square centimeter	Percent	after	
						2 days	3 days
<u>Percent</u>							
4-Thiazoline, 4-phenyl- 3-o-tolyl-2-(o-tolyl- imino)-	10 Armyworm	Fourth instar	Moderate	200	-	33	
	Celery leaf tier	Third instar	Much	200	-	17	
	Green dock beetle	Fourth instar	do.	230	0	-	
	Pea aphid	2-day-old nymphs	-	200	0 in 1 day	-	
	Two-spotted spider mite	Nymphs and adults	-	215	-	11	

Table 4. - - Experimental materials that were found to be practically nontoxic, killing less than 25 percent of the insects against which they were tested

Compound		Insect	Stage
	<u>Percent</u>		
Acetic acid, 2,4,5-trichlorophenyl ester	5	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs Nymphs and adults
Benzamide, N-benzoxyl-	5	Armyworm Celery leaf tier Large milkweed bug Pea aphid Two-spotted spider mite	Third instar do. Third-instar nymphs 2-day-old nymphs Nymphs and adults
Benzamide, N-hydroxy-	5	Celery leaf tier Green dock beetle Pea aphid Two-spotted spider mite	Third instar Fourth instar 2-day-old nymphs Nymphs and adults
Benzil, 4,4'-dichloro-	25	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs Nymphs and adults
Benzoic acid, p-chloro-, pentachlorophenyl ester	25	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs All stages
Benzoic acid, 2,4-dichloro-, p-bromophenyl ester	5	Armyworm Celery leaf tier Green dock beetle Large milkweed bug Pea aphid Two-spotted spider mite	Third instar do. Fourth instar Third-instar nymphs 2-day-old nymphs Nymphs and adults
Benzoic acid, 2,4-dichloro-, o-nitrophenyl ester	5	Celery leaf tier Pea aphid Two-spotted spider mite	Third instar Adults Nymphs and adults
Benzoic acid, 3,4-dichloro-, o-nitrophenyl ester	5	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs Nymphs and adults
Benzoic acid, 2,4-dichloro-, 4-tert-butyl-2-chlorophenyl ester	5	Armyworm Celery leaf tier Green dock beetle Pea aphid Two-spotted spider mite	Third instar do. Fourth instar 2-day-old nymphs Nymphs and adults

Table 4. - - (Continued)

Compound		Insect	Stage
<u>Percent</u>			
Benzoic acid, 2,4-dichloro-, pentachlorophenyl ester	5	Celery leaf tier	Third instar
		Pea aphid	Adults
		Two-spotted spider mite	Nymphs and adults
Benzoic acid, 3,4-dichloro-, pentachlorophenyl ester	5	Celery leaf tier	Fourth instar
		Pea aphid	2-day-old nymphs
		Two-spotted spider mite	Nymphs and adults
Benzoic acid, p-nitro-, m- tolyl ester	25	Armyworm	Fourth instar
		Celery leaf tier	do.
		Variegated cutworm	do.
Benzoxazole, 2-phenoxyethyl-	10	Armyworm	Third instar
		Celery leaf tier	do.
		Green dock beetle	Fourth instar
		Pea aphid	2-day-old nymphs
		Two-spotted spider mite	Nymphs and adults
Biuret, 2,4-dithio-	5	Celery leaf tier	Third instar
		Pea aphid	Adults
		Two-spotted spider mite	Nymphs and adults
Butane, 2,2,3-trichloro- 1,1-bis(p-chlorophenyl)-	10	Armyworm	Fourth instar
		Celery leaf tier	Third instar
		Pea aphid	2-day-old nymphs
		Two-spotted spider mite	Nymphs and adults
Caproic acid, 2,3,4,5- tetrabromo-	25	Celery leaf tier	Fourth instar
		Cabbage aphid	Nymphs and adults
		Pea aphid	2-day-old nymphs
		Two-spotted spider mite	Nymphs and adults
		Variegated cutworm	Fourth instar
Cyclopentadiene-, hexachloro-	5	Celery leaf tier	Third instar
		Pea aphid	Adults
		Two-spotted spider mite	Nymphs and adults
1,1,3,3-Cyclopentanetetra- propionitrile, 2-Oxo-	10	Armyworm	Fourth instar
		Celery leaf tier	Third instar
		Green dock beetle	do.
		Pea aphid	2-day-old nymphs
		Two-spotted spider mite	Nymphs and adults
Diphenylamine, 4-chloro-2- nitro-	10	Armyworm	Third instar
		Celery leaf tier	do.
		Pea aphid	3-day-old nymphs
		Two-spotted spider mite	Nymphs and adults

Table 4. - - (Continued)

Compound		Insect	Stage
	<u>Percent</u>		
Ethane, 1,1,1-trichloro- 2,2-bis(4-chloro-3,5- dinitrophenyl)-	25	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs Nymphs and adults
Ethylenediamine, bis(di- salicylal)-, cobalt derivative	25	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs Nymphs and adults
Ethylenediamine, bis(di- salicylal)-, ferrous derivative	25	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs Nymphs and adults
Ethylenediamine, bis(di- salicylal)-, zinc derivative	25	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs Nymphs and adults
Fumaric acid, bis(p- chlorophenyl) ester	25	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs Nymphs and adults
5(4)-Isoxazolone, 4-cinna- mylidene-3-methyl-	10	Celery leaf tier Green dock beetle Pea aphid Two-spotted spider mite	Third instar Fourth instar 2-day-old nymphs Nymphs and adults
Methanetripropionitrile, p-anisoyl-	10	Armyworm Celery leaf tier Pea aphid Two-spotted spider mite	Third instar co. 3-day-old nymphs Nymphs and adults
Methanetripropionitrile, benzoyl-	10	Armyworm Celery leaf tier Green dock beetle Pea aphid Two-spotted spider mite	Fourth instar Third instar Fourth instar 2-day-old nymphs Nymphs and adults
Methanetripropionitrile, p-chlorobenzoyl-	10	Armyworm Celery leaf tier Green dock beetle Pea aphid Two-spotted spider mite	Fourth instar Third instar Fourth instar 2-day-old nymphs Nymphs and adults

Table 4. - - (Continued)

Compound		Insect	Stage
	<u>Percent</u>		
Methanetripropionitrile, 2-naphthoyl-	10	Armyworm Celery leaf tier Pea aphid Two-spotted spider mite	Third instar do. 3-day-old nymphs Nymphs and adults
Methanetripropionitrile, <u>p</u> -toluyl-	10	Armyworm Celery leaf tier Green dock beetle Pea aphid Two-spotted spider mite	Fourth instar Third instar Fourth instar 2-day-old nymphs Nymphs and adults
Oxindole, 3-hydroxy-3- (nitromethyl)-	10	Armyworm Celery leaf tier Pea aphid Two-spotted spider mite	Third instar do. 3-day-old nymphs Nymphs and adults
Phenol, 4,4'-(2,2-dichloro- vinylidene)bis(2,6- dinitro)-	25	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs Nymphs and adults
Pimelonitrile, <u>gamma</u> -benzoyl- <u>gamma</u> -methyl-	10	Armyworm Celery leaf tier Pea aphid Two-spotted spider mite	Third instar do. 2-day-old nymphs Nymphs and adults
<u>beta</u> -Pinene-carbon tetra- chloride	5	Celery leaf tier Pea aphid Two-spotted spider mite	Third instar Adults Nymphs and adults
1,3-Propanediol, 2,2- bis(chloromethyl)-	10	Armyworm Celery leaf tier Green dock beetle Pea aphid Two-spotted spider mite	Third instar do. Fourth instar 2-day-old nymphs Nymphs and adults
1,3-Propanediol, 2,2- bis(chloromethyl)-, bis(2,4-dichlorobenzoate)	10	Celery leaf tier Green dock beetle Pea aphid Two-spotted spider mite	Third instar Fourth instar 2-day-old nymphs Nymphs and adults
1,3-Propanediol, 2,2-bis (chloromethyl-, bis(<u>p</u> - chlorobenzoate)	10	Celery leaf tier Green dock beetle Pea aphid Two-spotted spider mite	Third instar Fourth instar 2-day-old nymphs Nymphs and adults



Table 4. - - (Continued)

Compound		Insect	Stage
Percent			
1-Propanol, 3-chloro- 2,2-bis(chloromethyl)-	10	Celery leaf tier Green dock beetle Pea aphid Two-spotted spider mite	Third instar Fourth instar 2-day-old nymphs Nymphs and adults
1-Propanol, 3-chloro- 2,2-bis(chloromethyl)-, p-chlorobenzoate	10	Armyworm Celery leaf tier Green dock beetle Pea aphid Two-spotted spider mite	Third instar do. Fourth instar 2-day-old nymphs Nymphs and adults
1-Propanol, 3-chloro-2,2- bis(chloromethyl)-, 2,4- dichlorobenzoate	10	Armyworm Celery leaf tier Green dock beetle Pea aphid Two-spotted spider mite	Third instar do. Fourth instar 2-day-old nymphs Nymphs and adults
Pyridine, 2-(4-chloro- benzamido)-	10	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs Nymphs and adults
Quinoxaline, 2,3-bis(p- chlorophenyl)-	25	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs Nymphs and adults
Stilbene, 4,4'-dichloro-	25	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs Nymphs and adults
Stilbene, <u>meso</u> -dichloro-	10	Armyworm Celery leaf tier Green dock beetle Pea aphid Two-spotted spider mite	Third instar do. Fourth instar 2-day-old nymphs Nymphs and adults
Sulfone, benzyl p-chloro- phenyl	25	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs Nymphs and adults
Sulfone, bis(p-chlorobenzyl)	25	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs Nymphs and adults
Sulfone, p-chlorobenzyl phenyl	25	Celery leaf tier Pea aphid Two-spotted spider mite	Fourth instar 2-day-old nymphs Nymphs and adults